

A NEW SPECIES OF *BROWALLIA* (SOLANACEAE)  
FROM THE SOUTHWESTERN UNITED STATES AND  
NORTHWESTERN MEXICO

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ABSTRACT

*Browallia eludens* is a new short-lived summer annual species from the Canelo Hills, Santa Cruz County, Arizona, and west-central Chihuahua and southeastern Sonora, Mexico. It belongs in Section *Browallia* with three of the four other Central and South American species. They share a small corolla with rounded lobes and an uninflated calyx. *Browallia eludens* is distinguished by its narrow, sessile leaves, consistently whitish flowers, oversized calyx and larger, distinctively shaped seeds. It occurs primarily in riparian habitats in Madrean Evergreen Woodland in southern Arizona and the northern Sierra Madre Occidental. This is the first report for an indigenous species of the genus *Browallia* from the United States.

RESUMEN

Se describe *Browallia eludens*, sp. nov., anual con ciclo corto en verano, de Canelo Hills, Santa Cruz County, Arizona, y del centro-occidente de Chihuahua y sureste de Sonora, México. Pertenecce a la sección *Browallia* junto con otras tres de las cuatro especies de Centro y Sudamérica. Comparten una pequeña corola con lóbulos redondeados y cáliz no inflado. *Browallia eludens* se distingue por sus hojas estrechas, subsésiles, flores consistentemente blanquecinas, cáliz agrandado y semillas más grandes con forma distinta. Habita principalmente habitats riparios del bosque de pino y pino-encino del sureste de Arizona y del norte de la Sierra Madre Occidental. Este es el reporte primero del genero *Browallia*, de los Estados Unidos.

While on a botanical outing to the Canelo Hills of southern Arizona in August 1990, we discovered an interesting plant that could not be easily assigned to family. In the next year several additional collections of the plant from west-central Chihuahua (Laferriere 1991) and southeastern Sonora, Mexico, were brought to our attention. Further study revealed that this species belonged to the genus *Browallia*, a small group of neotropical annuals in the Solanaceae. Study of known material of *Browallia* showed these populations to be a new species.

SPECIES TREATMENT

*Browallia eludens* Van Devender & Jenkins, sp. nov. (Fig. 1). — TYPE:  
USA, Arizona, Santa Cruz Co., ca. 1.6 km N of Canelo Pass in  
Western Canyon, Canelo Hills, Coronado National Forest, T22S

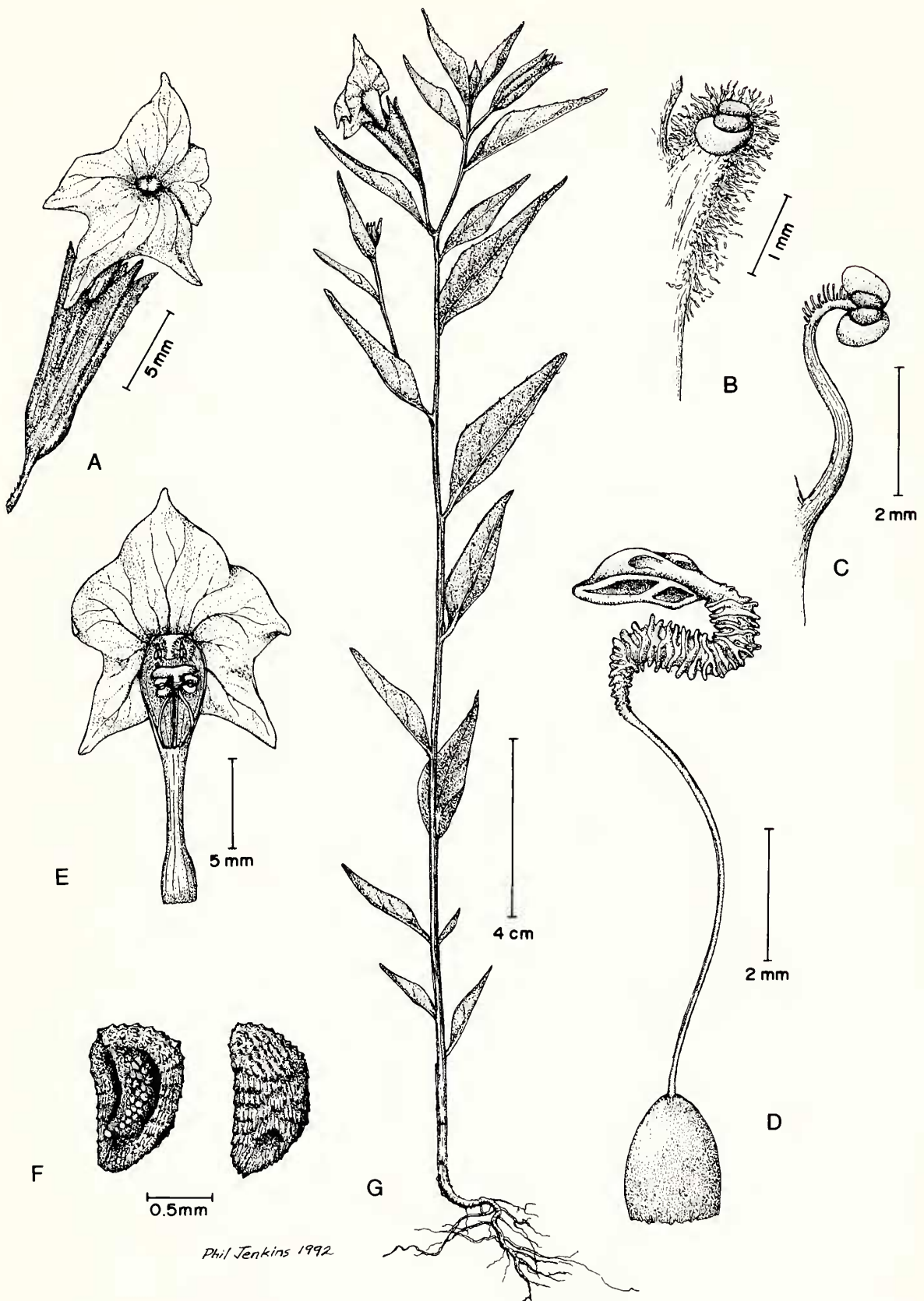


FIG. 1. *Browallia eludens*. A, flower. B, upper stamen. C, lower stamen. D, ovary, style and stigma. E, top view of flower with section of corolla removed to show position of stamens and stigma. F, seed: ventral surface with keel and hilum (left); dorsal surface (right). G, entire plant.

R18E S19, NW¼, 1600 m, 25 Aug 1990, *Van Devender 90-421* (holotype, ARIZ; isotypes; GH, MO, UC, US).

Herba annua, erecta, 8–30 cm alta, plerumque non ramosa. Folia alterna, integra, subsessilia vel brevi-petiolata, rhombici-lanceolata pro parte maxima, lineari-lanceolata superne, usque ad 4 cm longa et 1 cm lata, marginibus brevibus hispidi-ciliatis. Florae solitariae, axillares; pedicelli usque ad 15 mm longi. Calyx 8–15 mm longus, 5-lobatus et valde 5-plicatus, lobis leviter inaequalibus, acutis, ad 6 mm longis. Corolla zygomorpha, crenea vel flavida, hypocraterimorpha, limbo 5-lobato, 6–12 mm lato, tubo et fauce 10–17 mm longo, vix exserto calyce et protuberatione adaxiale ad faucem. Stamina 4, didinama; antherae paris superi utraque ferens thecam abortivam unicam; filamenta staminum superiorum applanata, marginibus dense lanati-pubescentibus; filamenta staminum inferiorum angusta, semel geniculata et pubescentia solum superne. Ovarium viridum, glabrum; stylus semel geniculatus superne; stigma late 2-lobatum, tegens ambas antheras staminum inferiorum. Capsula bivalvis, omnino inclusa calyce accrescenti. Semina circa 1.5 mm longa, numerosa, brunnea vel ligno-brunnea, minute reticulata et papillata.

Erect annuals 8–30 cm tall, typically unbranched; stems minutely pubescent in lines with short, incurved hairs. Leaves alternate, entire, subsessile or short-petiolate, to 4 cm long and 1 cm wide, prevailingly rhombic-lanceolate, the upper becoming linear-lanceolate; blade short hispid-ciliate along the margins and sometimes sparsely on veins below. Flowers solitary, axillary, on pedicels to about 15 mm long, only 1 or 2 opening simultaneously. Calyx 8–15 mm long, 5-lobed, strongly plicate along midrib of each lobe, hispid-ciliate on margins and plicae; lobes slightly unequal, acute, to 6 mm long. Corolla zygomorphic, cream-colored (pale yellow in age), salverform, the limb 6–12 mm across, declined obliquely on the tube, 5-lobed with tips reflexed; tube including throat 10–17 mm long, scarcely exserted from the calyx, lightly glandular-puberulent outside; throat ventricose adaxially, the swelling formed by the cluster of stigma and anthers of the 2 lower stamens. Stamens 4, didynamous; anthers of upper pair each with one abortive theca, the filaments flattened and expanded, densely ciliate with long, woolly and somewhat viscid hairs, the apices of the filaments curved downward and closing the mouth of the corolla, sometimes exposing the abortive thecae; anthers of lower pair each with 2 fertile thecae, the filaments narrower, once-geniculate and pilose only near apices. Ovary glabrous, green, 2-celled with axile placentation; style once-geniculate near apex and strongly convoluted the length of bend; stigma a broadly 2-lobed expanded cap, the ventral surface bearing 2 pockets which enfold the anthers of lower stamens. Fruit a 2-valved

septicidal capsule included in the accrescent calyx; seeds about 1.5 mm long, numerous, tan or dark brown at maturity, excavated on the inner (concave) surface except for a central keel, minutely reticulate; outer (convex) surface rounded and minutely papillate.

PARATYPES: USA, Arizona, Santa Cruz Co., ca. 1.6 km N of Canelo Pass in Western Canyon, Coronado National Forest, 1600 m, 11 Aug 1990, *Van Devender 90-367* (ASU); Western Canyon, T22S R18E S18, SW $\frac{1}{4}$ , 1600 m, 19 Aug 1990, *Jenkins 90-91* (ARIZ, F). MEXICO, Chihuahua, ridge W of Moris, 28°08'N, 108°35'W, 1500 m, 19 Aug 1989, *Martin & Jenkins 89-313* (ARIZ); km 89 on road from Basaseachic to San Juanito, 28°09'N, 108°9.8'W, 2100 m, 15 Aug 1989, *Martin, Rondeau & Jenkins 89-184* (ARIZ); Municipio Temosachic, 1 km N of Nabogame, 28°30'N, 108°30'W, 1800 m, 29 Aug 1987, *Laferriere 1003* (NMC, VDB); 3 km N of Nabogame, 27 Jul 1988, *Laferriere 1562* (TEX, VDB); Nabogame, 8 Aug 1988, *Laferriere 1629* (ARIZ, MEXU, VDB); Rancho Byerly, Sierra Charuco, 1350–1700 m, summer 1946, *Langille 71* (ARIZ). Sonora, "El Rayo" on the way to Milpillas, 27°15'20"N, 108°37'50"W, 1430 m, 18 Aug 1991, *Martin & Jenkins 91-84* (ARIZ).

*Comparison with other species.* Unlike most other Solanaceae, *Browallia* has a zygomorphic corolla and four didynamous stamens. The anthers of the upper pair each bear one abortive and one fertile theca. In this genus alone the upper anthers curve downward, elevating the flattened, densely ciliate filaments that effectively close the very small mouth of the corolla (D'Arcy 1978).

Although 27 species of *Browallia* have been described, only four are currently recognized (W. G. D'Arcy personal communication 1991). *Browallia eludens* differs from these in a number of morphological characters. It is typically unbranched with consistently narrow, sessile leaves. The other species are usually much branched with primarily ovate, petiolate leaves.

*Browallia eludens* has whitish flowers turning pale yellow with age and the corolla tube is scarcely exerted from the comparatively oversized calyx. The others, especially *B. americana*, are noted for variable flower colors, typically some shade of blue, but ranging from white to purple. A white or yellow eye is often apparent in the throat. The corolla tube is well exerted in these species, due to the relatively smaller calyx.

The pollen morphology of *Browallia eludens* differs from that of *B. americana* (Gentry 1979) and the Solanaceae in general (Punt and Monna-Brands 1980) which are typically tricolporate and striate. In a scanning electron microscope (SEM) image, the unacetylated pollen grain of *Browallia eludens* appears inaperturate with a scabrate surface (Fig. 2). Pollen were examined from the upper and lower anthers of 10 flowers. Grains were teased from the anthers,



FIG. 2. Scanning electron microscope photo of an unacetolyzed pollen grain of *B. eludens* from Canelo Hills, Arizona. Note scabrate surface and apparent lack of apertures.

mounted in glycerin jelly, and stained with basic fuchsin for quick examination. Pollen were  $37 \times 40 \mu\text{m}$  in size. Some grains appeared to be striate with 3–6 colpae (commonly 4 or 5) with a small polar index (PAI = 0.90; Fig. 3). The dense ectexinous elements in the colpae contribute to the inaperturate appearance of the pollen grain under SEM. Grains from upper and lower anthers may mature at different rates because some appeared thin walled and striate while others appeared thicker walled and scabrate. Acetolysis was performed three times on separate samples. Pollen fragments were found after each extraction attempt, but entire pollen grains were never recovered. Within three months pollen in the glycerin mounts had appreciably disintegrated suggesting that the exine is very fragile.

The seeds of *Browallia eludens* (typically 1.5 mm long) are larger than those of the other species, which seldom reach 1 mm. They are excavated on the inner side and rounded on the back, resembling most closely seeds of *B. acutiloba*. The other species have strongly prismatic seeds. Only *B. eludens* has seeds which bear a prominent longitudinal keel on the concave (ventral) side.

It is difficult to determine, with the information available to us, the closest relative of *B. eludens*. The small flowers with shallow,

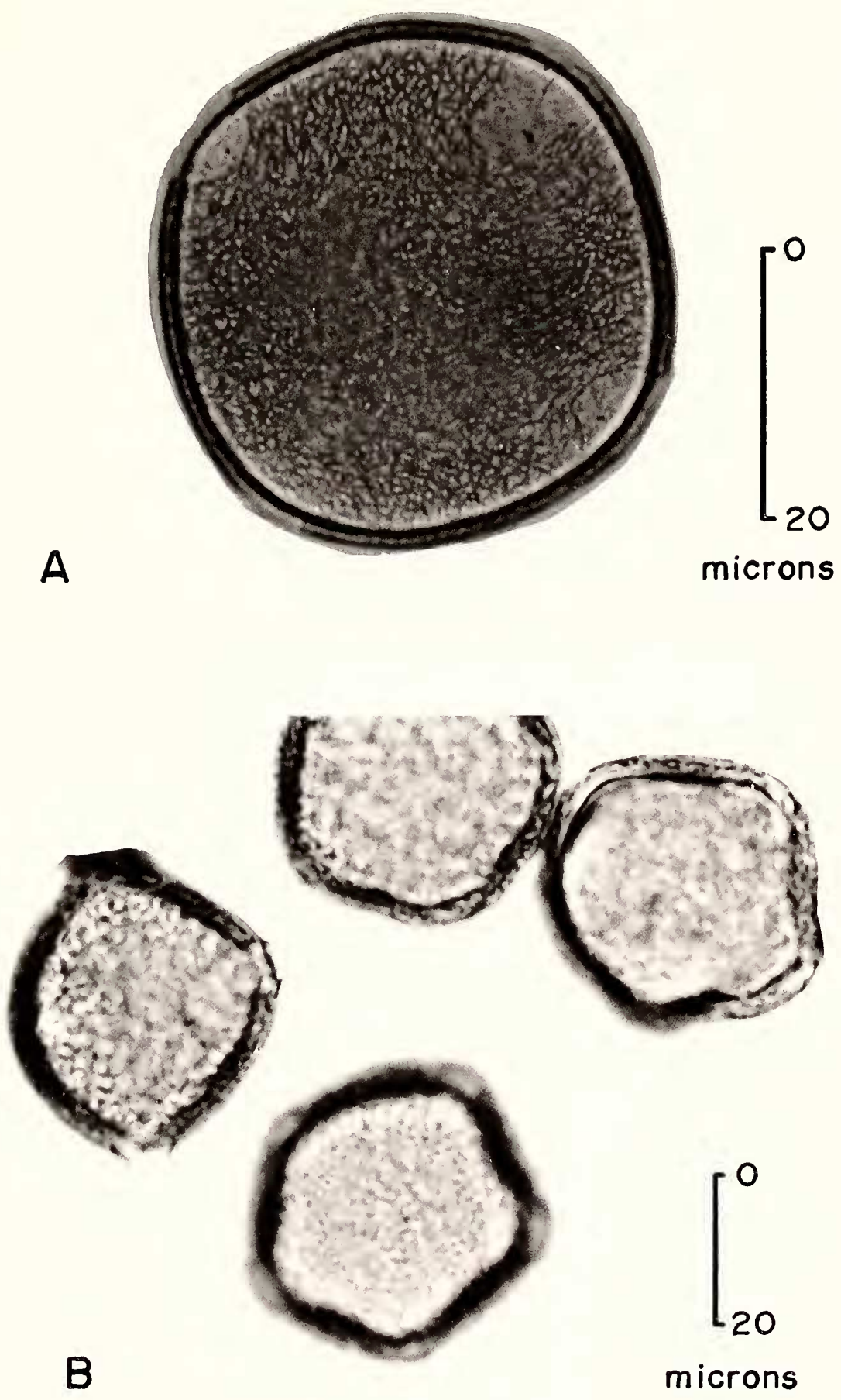


FIG. 3. Light micrographs of pollen grains of *B. eludens*. A, 4-colpate grain with striate appearance. B, 4- and 5-colpate grains with scabrate surface.

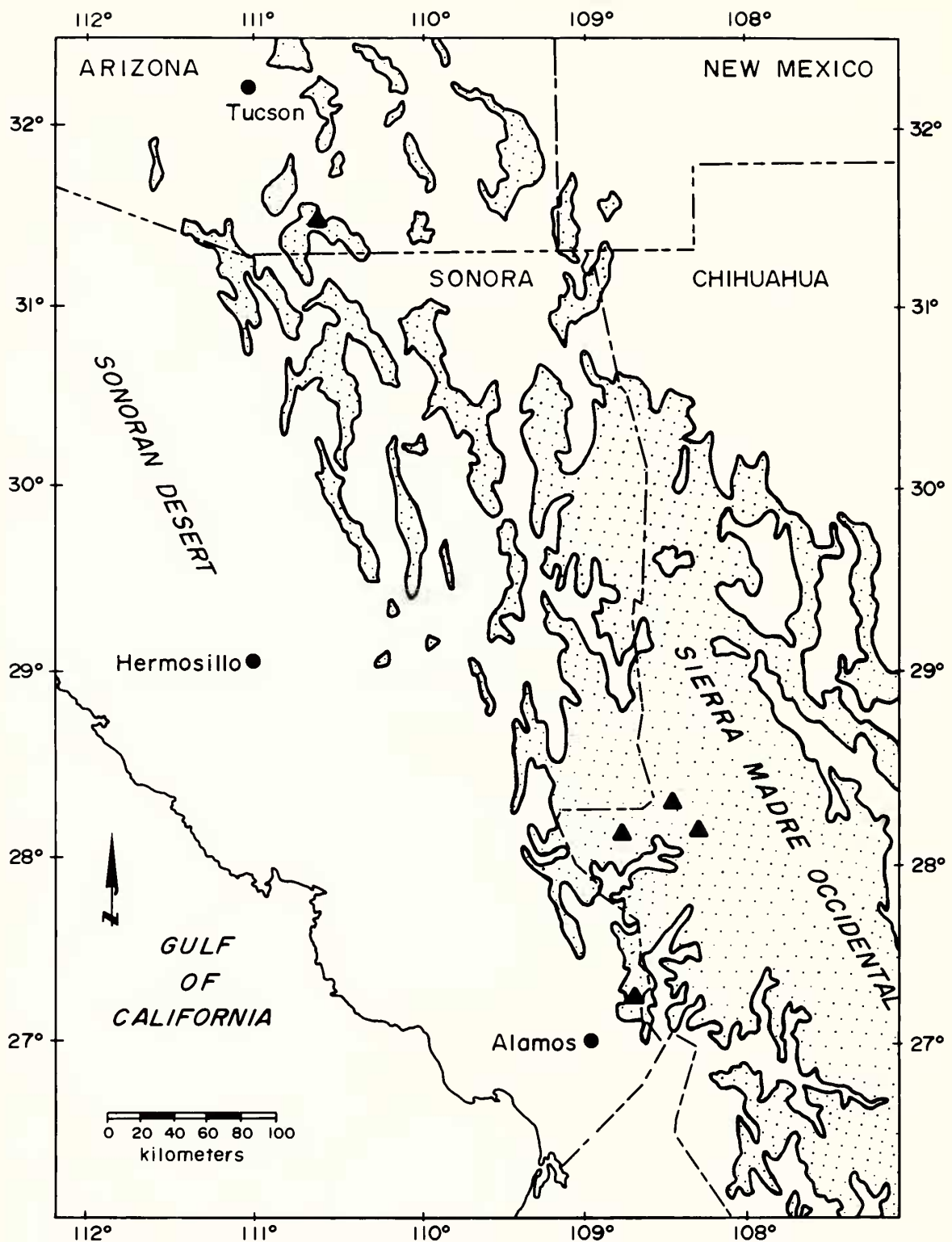


FIG. 4. Distribution map of *Browallia eludens*. Triangles = collection localities; stippled area = Sierra Madran Woodland and Forest, after Brown and Lowe (1980).

rounded corolla lobes and uninflated calyx would indicate it belongs in Sect. *Browallia*, which includes the most northern of the species, *B. americana*, and the closely related *B. viscosa*, formerly regarded as a glandular form of *B. americana* (D'Arcy 1973). Sagástegui Alva and Díos Carranza (1980) described *B. acutiloba* from the lowlands

of northern Peru, suggesting it was most similar to *B. speciosa*. However, the large flowers, deeply pointed corolla lobes and inflated calyx of *B. speciosa* are so unusual that D'Arcy (1973) referred it to a separate section, Sect. *Leiogyne*. We believe that *B. acutiloba* belongs more properly in Sect. *Browallia* because it shares the corolla and calyx features of species placed in that section.

*Distribution, habitat and phenology.* *Browallia eludens* is currently known from disjunct populations in southeastern Arizona, west-central Chihuahua, and southeastern Sonora, Mexico, from 31.5° to 27.2°N latitude (Fig. 4). The localities vary from 1400–2100 m where the dominant species are various evergreen oaks and Mexican pines characteristic of Madrean Evergreen Woodland (Brown 1982). At the type locality in the Canelo Hills the vegetation is oak woodland dominated by Emory oak (*Quercus emoryi*) with scattered alligator bark juniper (*Juniperus deppeana*). In Mexico *B. eludens* occurs in oak and pine-oak woodland and, at the highest known elevation, in transitional pine forest. At the lower or drier sites Chihuahua oak (*Q. chihuahuensis*) is often a dominant. It is variously associated with other evergreen oaks (*Q. coccolobifolia*, *Q. crassifolia*, *Q. durifolia*, *Q. oblongifolia*, *Q. viminea*) and madrone (*Arbutus arizonica*, *A. xalapensis*). At higher elevations oak woodland is replaced by pine-oak woodland. Some of the same oaks intermingle with pines (*Pinus arizonica*, *P. durangensis*, *P. oocarpa*). At 2100 m pine-oak woodland gives way to pine forest dominated by Durango pine (*P. durangensis*) mixed with Arizona pine (*P. arizonica*). Oaks, particularly *Q. crassifolia*, are present, but in much fewer numbers than pines (P. S. Martin and J. E. Laferriere personal communication 1991).

*Browallia eludens* grows on soils derived from rhyolitic or andesitic volcanic rocks. In Arizona the plants were found only on wet soils in the relatively flat (<30% slope) flood zone of an intermittent stream. Steady stream flow with occasional flooding was evident in August 1990, the year of collection, due to exceptional summer rains. A nearby weather station at Canelo (ca. 5 km NE; 1527 m) recorded 320 mm precipitation for July and August, more than 100 mm above normal (NOAA 1990). In contrast, *B. eludens* was not found in the summer of 1991 with scanty precipitation. Although the Canelo station was no longer active, data from the nearest stations at Sierra Vista (ca. 25 km east; 1402 m) and Patagonia (ca. 20 km west; 1277 m) recorded only 132–142 mm precipitation for July and August (State Climatological Laboratory personal communication 1991). Although these stations were in somewhat lower, and therefore drier, areas the decrease in precipitation is significant.

In Mexico *Browallia eludens* was found in mesic, but not strictly riparian, situations including a wet meadow and a dripping, andesitic rock outcrop, as well as a stream floodplain. Summer rain is more



predictable in the Sierra Madre than in Arizona with more extended periods of moist soil.

To date, *B. eludens* has only been collected in August. The plants apparently senesce with the onset of drier conditions during September.

#### DISCUSSION

The discovery of *B. eludens* is interesting in several respects. It is widely disjunct from any of its relatives, which are native to southern Mexico, Central and South America. *Browallia americana*, the most widespread species, has long been cultivated in tropical and subtropical America where it often escapes to flourish in disturbed areas (Hunziker 1979). It is common in coffee plantations of central Veracruz (Nee 1986) and is known from as far north as Tepic, Nayarit (E. Palmer, 2026, New York).

*Browallia eludens* is apparently confined to more temperate elevations (1400 to 2100 m) where summers are relatively cool and freezing temperatures routinely occur in winter. Its lower elevational limits appear to be set by sporadic summer precipitation coupled with high temperatures and low humidity, and its upper limits perhaps by cool soil temperatures. Its short, ephemeral life cycle probably permits the species to occupy a niche in woodland during the warm, wet summer, existing as seed during winter. We do not know germination requirements, although we speculate that warm, wet soils are necessary and that the seeds remain dormant for long periods awaiting adequate summer rainfall.

*Browallia eludens* appears to be tracking the boundaries of Madrean Evergreen Woodland, a mild winter-wet summer woodland centered in the Sierra Madre Occidental. A suite of other tropical and subtropical plants including coralbean (*Erythrina flabelliformis*), mala mujer (*Cnidocolus angustidens*) and manihot (*Manihot angustiloba*) reach their northern limits in this woodland which extends north to the mountains of southeastern Arizona (northwest to Yavapai County) and into southwestern New Mexico and Trans-Pecos Texas (Brown 1982). In these outlying areas we expect *B. eludens* to occur only sporadically, and in canyons where water is concentrated. In the Sierra Madre with dependable summer rainfall *B. eludens* undoubtedly occurs more frequently and is more widespread.

We were surprised to find a new species, much less one in a tropical genus, in such a well-botanized area. Considering the hundreds of plants in the two Canelo Hills populations, it is doubtful that *B. eludens* has only recently migrated north into Arizona. More likely, the species has been overlooked for several reasons due to its diminutive size, unobtrusive appearance, short life cycle, sporadic occurrence only in wet summers and limited distribution in canyon

riparian woodland habitats. After searching in vain for *Browallia* at the type locality in 1991, its ephemeral and illusive nature suggested to us the epithet, "*eludens*."

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#### LITERATURE CITED

- BROWN, D. E. 1982. Madrean evergreen woodland. *Desert Plants* 4:59–65.
- and C. H. LOWE. 1980. Biotic communities of the southwest. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-78.
- D'ARCY, W. G. 1973. Flora of Panama (family 170. Solanaceae). *Annals of the Missouri Botanical Garden* 60:573–780.
- . 1978. A preliminary synopsis of *Salpiglossis* and other Cestreae (Solanaceae). *Annals of the Missouri Botanical Garden* 65:698–724.
- GENTRY, J. L., Jr. 1979. Pollen morphology of the Salpiglossideae (Solanaceae). Pp. 327–334 in J. G. Hawkes, R. N. Lester, and A. D. Skelding (eds.), *The biology and taxonomy of the Solanaceae*. Academic Press, London.
- HUNZIKER, A. T. 1979. South American Solanaceae: a synoptic survey. Pp. 49–85 in J. G. Hawkes, R. N. Lester, and A. D. Skelding (eds.), *The biology and taxonomy of the Solanaceae*. Academic Press, London.
- LAFERRIERE, J. E. 1991. Range extensions in the Sierra Madre Occidental, Chihuahua, Mexico. *Phytologia* 70:188–193.
- NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION. 1990. Climatological data. *Arizona* 94(7):1–35, (8):1–39.
- NEE, M. 1986. Solanaceae I. Pp. 8–13 in *Flora de Veracruz*. INIREB, Xalapa, Veracruz.
- PUNT, W. and M. MONNA-BRANDS. 1980. Solanaceae. Pp. 1–30 in W. Punt and G. C. S. Clarke (eds.), *The northwest European pollen flora, II*. Elsevier, Amsterdam.
- SAGÁSTEGUI, A., A. and O. DÍOS C. 1980. Una nueva especie del genero *Browallia* (Solanaceae). *Hickenia* 1:215–217.

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